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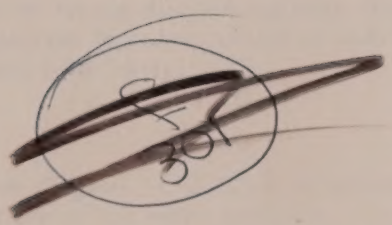
WAVE ANALYZER
MODEL 121



Manufactured by

SIERRA ELECTRONIC CORPORATION
1050 Britton Avenue
San Carlos, California

Serial #112 and Above

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OPERATING AND MAINTENANCE INSTRUCTIONS

for

MODEL 121 WAVE ANALYZER

1. GENERAL

The Sierra Model 121 Wave Analyzer is a gain-calibrated double-superheterodyne receiver of sharp selectivity and low spurious frequency response characteristics, specifically designed to measure signal frequency components in the range 15 kc to 500 kc. It features a high input impedance (10,000 ohms in the pass band) and is direct reading in dbm when bridged across a 600 ohm unbalanced circuit. A pair of step attenuators and an indicating meter with a db scale provide a sensitivity range of -70 dbm to +42 dbm under these conditions, corresponding to an input voltage level range of 245 microvolts to 97.5 volts.

The wave analyzer is equipped with an injection oscillator (in effect, a signal generator) for the purpose of calibrating its sensitivity to input voltages. An additional feature which is provided in the instrument is a jack for monitoring the received signals with headphones.

A special tuning dial having both "normal" and "fine tune" knobs is used on the wave analyzer to permit maximum utilization of the instrument's wide tuning range and sharp selectivity.

2. DESCRIPTION

A block diagram, E-3717-2, is included herewith to help the user understand the functions of the wave analyzer. As shown, the signal input first passes through a section which includes an input filter and the INPUT LEVEL attenuator, before arriving at the grid of the first mixer tube. The input filter is a bandpass variety with a pass band from 15 kc to 500 kc. Its purpose is to suppress signals outside this band. The INPUT LEVEL attenuator serves to reduce by known amounts the signal arriving at the grid of the first mixer tube, so as to increase the voltage measuring range of the instrument and make possible the measurement of relatively large voltages. This attenuator and its associated circuit connections serve to limit the voltage magnitude of the maximum signal component impressed on the first mixer grid to a value which is well below the point at which significant mixer harmonic distortion of intermodulation effects are produced. The INPUT LEVEL attenuator steps are in 10 db intervals and accommodate the input level range from 0 dbm up to +40 dbm.

The TUNING DIAL on the front of the wave analyzer is calibrated to indicate the input signal frequency directly in kc. This control established the heterodyne frequency of the variable local oscillator in the range 1125 kc to 1610 kc. The output of this oscillator heterodynes with the incoming signal in the 1st mixer tube to produce, by "difference" mixing an intermediate frequency (I.F.) of 1110 kc. After passing through a highly-selective 1110 kc

Schem. Ref. No.	Description	Use	Name of Mfgrs.	Drawing Or Mfgrs. No.
C1	Capacitor, fixed, silver mica, .003 mfd ±2%, 500 V. DCW, CM-30 case	Input Filter	El-Menco	CM30E302
C2	" " " " " " " " " "	" "	"	"
C3	" " " " 50 mmf " " " CM-15 "	" "	"	"
C4	" variable, ceramic, 1.5-7 " 350 " zero coeff.	Neutralizing	Erie	CM15E500
C5	" fixed, " .02 mfd(GMV), 500 " disc.	By-Pass	Centralab	557, NPO
C6	" " " .1 " " 600 " Flat Hi-Kap	"	"	DD-203
C7	" " " " " " " " " "	"	"	DF-104
C8	" silver mica, .001 mfd ±3%, 500 V. DCW, CM-19 case	1110 K.C. I.F.	El-Menco	"
C9	" adjustable, air, 0.1-1.0 mmf, Special	"	"	CM19D102
C10	" fixed, silver mica, .001 mfd ±3%, 500 V. DCW, CM-19 case	"	Sierra	SU-3708-1
C11	" variable, ceramic, 1.5-7 mmf, 350 " zero coeff.	Neutralizing	El-Menco	CM19D102
C12	" fixed, silvermica, .0016 mfd ±3%, 500 " CM-20 case	Xtal. Osc.	Erie	557, NPO
C13	" " ceramic, .01 " (GMV) 500 " disc.	By-Pass	El-Menco	CM20D162
C14	" " silver mica, .001 " ±5% 500 " CM-15 case	Xtal Osc.	Erie	811
C15	" " paper , .25 " +20%-10%, 400 V. DCW, molded	B+ By-Pass	El-Menco	CM15E101
C16	" " ceramic .1 " (GMV) 600 " Flat Hi-Kap	By-Pass	Sangamo	3004025
C17	" " silver mica, .003 " ±2%, 500 V. DCW, CM-30 case	30 K.C. I.F.	Centralab	DF-104
C18	" variable, mica, 265-880 mmf, 500 " Padder	" "	El-Menco	CM30E302
C19	" " , ceramic, 4.5-25 mmf, 500 " zero coeff.	" "	El-Menco	306-M
C20	" " , mica, 265-880 " 500 " Padder	" "	Erie	TS2A, NPO
C21	" fixed, silver mica, .003 mfd ±2% 500 " CM-30 case	" "	El-Menco	306-M
C22	" " , ceramic .01 " (GMV), 500 " disc.	" "	El-Menco	CM30E302
C23	" " " .1 " " 600 " Flat Hi-Kap	Blocking	Erie	811
C24	" " " .01 " " 500 " disc.	By-Pass	Centralab	DF-104
C25	" " " .001 " " 500 " "	Blocking	Erie	811
		"	"	801

Parts list for

MODEL 121 WAVE ANALYZER

Schematic Diagram No. E-3561-4

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SIERRA ELECTRONIC CORPORATION

SA-3562-1 • 4160-1

band-pass transformer circuit in the output of the 1st mixer, the 1110 kc signal then heterodynes with a 1080 kc crystal-controlled oscillator signal in the 2nd mixer tube to produce a second intermediate frequency of 30 kc. This 30 kc I.F. signal passes through a highly-selective 30 kc band-pass transformer circuit in the output of the 2nd mixer tube and is then applied to a cathode-follower stage, the output of which feeds the main ATTENUATOR. At the same time, a crystal diode detector circuit and subsequent audio frequency (A.F.) amplifier stage (including the A.F. GAIN control) extract any modulation present on the signal and deliver this modulation signal to the PHONES jack for audio monitoring purposes.

The steps of the main ATTENUATOR are in 10 db intervals and accommodate the range of input signal levels from 0 dbm down to -60 dbm. Since this attenuator operates at the fixed frequency of 30 kc, it has a high order of accuracy. Signal from the main ATTENUATOR is applied to a 30 kc I.F. amplifier section comprising a pair of pentodes and their associated tuned circuits. The first of these pentode stages contains the I.F. GAIN control which is provided for adjusting the overall gain of the wave analyzer to its standard value. The second of these pentode stages feeds a crystal diode detector, the d-c output of which operates the INDICATING METER.

The INDICATING METER on the front panel has a 0-200 microampere range, but the scale is marked +2 to -25 decibels. The calibrations indicate in decibels the ratios of voltages at the input terminals of the wave analyzer. Although the meter is protected for moderate overloads, caution should be exercised to avoid large off-scale deflections in the interest of preserving calibration accuracy.

An injection oscillator, which operates at 100 kc, is included in the wave analyzer. This oscillator provides a fixed known amplitude signal which can be switched to the input circuit and substituted for the incoming signal for gain standardization purposes. This oscillator is activated by switching the INJECTOR switch to the CAL position. The injection oscillator circuit contains a vacuum tube voltmeter for monitoring the amplitude of oscillation, to insure an accurate injection signal level component of 0.775 volts at 100 kc. (0.775 volts is the amplitude developed when 1 milliwatt of power, i.e. "O" dbm, is delivered to a 600 ohm load.). The d-c output from the vacuum tube voltmeter circuit is also indicated on the INDICATING METER, when desired, by switching the METER switch to the CAL position while the INJECTOR switch is also in the CAL position.

The d-c supply voltages used in the wave analyzer are regulated in the power supply section by means of an electron tube voltage regulator circuit. The object of this arrangement is to insure relatively constant voltage in the instrument under conditions where the 115 V supply is not constant.

The Model 121 Wave Analyzer is designed to operate from a power line of 115 volts, 50/60 cycles. It will operate satisfactorily in the range from 105 volts to 125 volts. The OFF-ON power switch is incorporated in the A.F. GAIN control; turn clockwise for ON position. The total power consumption is approximately 85 watts.

Schem Ref. No.	Description	Use	Name of Mfgrs.	Drawing Or Mfgrs. No.
C26	Capacitor, fixed, ceramic, .02-.02 mfd (GMV), 500 V. DCW, disc.	By-Pass	Sprague	5HK-252
C27	" " electrolytic, 25 " 25 " tubular	"	"	TVA-1205
C28	" " ceramic, .02 " (GMV) 500 " disc.	Blocking	Centralab	DD-203
C29	" " " .01 " " 500 " "	"	Erie	811
C30	" " " .001 " " 500 " "	"	"	801
C31	" " " .1 " " 600 " Flat Hi-Kap	By-Pass	Centralab	DF-104
C32	" " " " " " 600 " "	"	"	"
C33	" " " " " " 600 " "	"	"	"
C34	" " silver mica, .0016 " ±3%, 500 " CM-20 case	30 K.C. I.F.	El-Menco	CM20D162
C35	" " ceramic, .01 " (GMV) 500 " disc.	Blocking	Erie	811
C36	" " " .1 " " 600 " Flat Hi-Kap	By-Pass	Centralab	DF-104
C37	" " " " " " 600 " "	"	"	"
C38	" " " " " " 600 " "	"	"	"
C39	" " paper .25 " +20%-10%, 400 V. DCW, molded	"	Sangamo	3004025
C40	" " silver mica, .0016 mfd ±3%, 500 " , CM-20 case	30 K.C. I.F.	El-Menco	CM20D162
C41	" " ceramic, .02 " (GMV) 500 " disc.	Blocking	Centralab	DD-203
C42	" " " .02-.02 mfd (GMV), 500 V. DCW, disc.	By-pass	Sprague	5HK-252
C43	" " silver mica, 50 mmf ±2%, 500 " molded	100 K.C. Osc.	El-Menco	CM15E500
C44	" " ceramic, .02-.02 mfd (GMV) 500 " disc.	By-Pass	Sprague	5HK-252
C45	" " " .01 " " 500 " "	"	Erie	811
C46	" " " " " " 500 " "	"	"	"
C47	" " " .001 " " 500 " "	Coupling	"	801
C48	" " " " " " 500 " "	"		
C49	" " " .02-.02 mfd (GMV) 500 " "	By-Pass	Sprague	5HK-252
C50	" " " 47 mmf ±5% 500 " Neg. coeff.	Coupling	Erie	N750K47 ±2.5

Parts list for

MODEL 121 WAVE ANALYZER

Schematic Diagram No. E-3561

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A fuse for the power line is located in a holder on the front panel and is available for replacement by unscrewing the black cap marked FUSE. Replacement fuses should be rated at 3 amperes and should be of the Littelfuse or Bussman 3 AG type.

3. PERFORMANCE CHARACTERISTICS

3a. Sensitivity: The wave analyzer is capable of measuring voltage amplitudes from 245 microvolts to 97.5 volts, corresponding to power levels on a 600 ohm circuit of from -70 dbm(using the upper portion of the INDICATING METER scale between -10db and +2 db). Over the frequency range 15 to 500 kc the combined accuracy of any attenuator setting plus meter reading (in the upper portion of the meter scale) is ±2db. Additional sensitivity may be obtained by using the METER scale below the -10 db point. However, these measurements will be less accurate.

3b. Frequency Calibration: The tuning dial, which is calibrated to indicate the 15 to 500 kc input signal frequency range directly in kc, depends for its accuracy upon the calibration accuracy and stability of the 1125 to 1610 kc variable oscillator. Since this oscillator is calibrated and maintained to within 0.2%, the resulting tuning dial accuracy will range from ±2 kc at the low frequency end of the dial to ±3 at the high frequency end.

3c. Selectivity: At frequencies 100 cps off resonance, the response is approximately 3 db down. At 200 cps off resonance, the response is at least 10 db down; at 500 cps, at least 30 db; and at 1000 cps, at least 45 db.

3d. Spurious Responses: Spurious responses attributable to the wave analyzer circuits are at least 50 db below the level of the maximum input signal component being measured, when the instrument is operated in accordance with the operating instructions given below. Representative values are as follows:

A. Harmonic Distortion

1.) 2nd harmonic: -60 to -70db
2.) 3rd harmonic: -55 to -62 db
3.) Higher harmonics: better than -70db

B. Direct I.F. Responses

1.) 1110 kc (1st I.F.): -51 to -57 db
2.) 30 kc (2nd I.F.): better than -70 db

C Image Responses

1.) First Mixer (2220 kc above tuning dial setting): better than -60 db
2.) Second Mixer (60 kc above tuning dial setting): -53 to -58 db

Schem Ref. No.	Description	Use	Name of Mfgrs.	Drawing Or Mfgrs. No.
C51	Capacitor, variable, air, 53 mmf nom. eff. capac.	Var. Osc. Tuning	Oak	SS-3581-1
C52	" " ceramic, 5-30 mmf, 350 V. DCW, Neg. coeff	Trimmer	Erie	557, N750
C53	" fixed, paper, .1 mfd, 250 V. ACW, Hy-Pass	By-Pass	Sprague	48P9
C54	" " electrolytic, 20-20-20 mfd, 450 V. DCW. can.	P. S. Filter	Sangamo	PLT-4520
C55	" " ceramic, .01 mfd (GMV), 500 " disc.	By-Pass	Erie	811
C56	" " " .1 " " 600 " Flat Hi-Kap	Regulator	Centralab	DF-104
C57	" " paper, .1 " 250 V. ACW Hy-Pass	By-Pass	Sprague	48P9
C58	" " silver mica, 27 mmf ±5%, 500 V. DCW. CM-15 case	I. F. Trap	El-Menco	CM15E270
C59	" " " " " 500	Blocking	"	"
C60	" silver mica, 27 mmf ±5%, 500 V. DCW. CM-15 case	I. F. Trap	El-Menco	CM15E270
BP1	Binding Post Assembly, dual (pair)	Input	Millen	37202
CR1	Crystal rectifier, germanium type 1N34	Audio Det.	Sylvania	1N34
CR2	" " " " "	Mod. Det.	"	"
F1	Fuse, 3 amperes, type 3AG	A.C. Line	Littelfuse	312003
I1	Indicator Lamp, 6-8 volt, 0.15 amp, bayonet base, T3-1/4 bulb	Pilot Light	Nat. Union	[illegible]
J1	Jack, phone, single closed circuit, 2-conductor	Phones	Switchcraft	[illegible]

Parts list for

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3e. Input Impedance: The input impedance of the wave analyzer in the pass frequency band 15 to 500 kc is equivalent to approximately 10,000 ohms resistance shunted by 25 mmfds of capacitance. Outside the pass band the impedance rises in magnitude but becomes predominantly reactive in sign.

4. OPERATING INSTRUCTIONS

4a. Calibration Using Injector Oscillator: The injection oscillator is adjusted at the factory to deliver a 100 kc signal level of 0.775 volts (equivalent to 0 dbm on 600 ohms) to the wave analyzer input for calibrating purposes when the INJECTOR switch on the front panel is placed in the CAL position. The switch changes the internal circuit from the IN (input) terminal to the injection oscillator output (see block diagram) and at the same time connects the plate voltage to the oscillator.

In order to make certain that the amplitude from the injector oscillator is correct, the d-c output from the diode vacuum tube voltmeter circuit in the injector oscillator may be switched to the indicating meter by placing the METER switch in the CAL position. The circuit is adjusted at the factory to indicate "0" db on the meter when operating normal.

To use the injector for calibration:

4a1. Turn the wave analyzer ON by rotating the A.F. GAIN control knob clockwise from its extreme counter-clockwise position. Allow the instrument to warm up for at least 20 minutes.

4a2. Place the INJECTOR switch in the CAL position.

4a3. Place METER switch in the CAL position. The indicating meter should show "0" db.

4a4. Return the METER switch to the REC position, set the INPUT LEVEL and ATTENUATOR dials both at "0" dbm, and adjust the frequency dial for maximum reading on the indicating meter when tuned to the 100 kc injector oscillator signal. If the resultant meter reading is not "0" db it should then be set to this value by means of the I.F. GAIN control knob. The wave analyzer sensitivity is now adjusted to its standard gain value.

4a5. Return the INJECTOR switch to the REC position. The wave analyzer is now ready for making measurements.

Schem Ref. No.	Description	Use	Name of Mfgrs.	Drawing Or Mfgrs. No.
L1	Inductor, fixed, universal, 2.5 MH ±3%, iron dust core, 19.5 ohms d.c.	Input Filter		SS-3425-2-2
L2	" " " " " " " " " " " "	"		"
L3	" " " 100 " " " " " 210 " "	"		SS-3425-2-3
L4	" variable " 18-20.5 μh " " cup core, Q 150	1110 kc I.F.	Secor	SS-3547-1
L5	" " " " " " " " " "	" "	"	"
L6	" fixed " 2.5 MH ±3%, " " core, 19.5 ohms d.c.	Xtal. Osc.		SS-3425-2-2
L7	" " toroidal, 6.0 MH ±1%, stabilized " Q 180 @ 30 kc	30 kc I.F.	Lenkurt	Type TLFX
L8	" " " " " " " " " "	" "	"	" "
L9	" universal, 150 " ±3%, iron dust core, 268 ohms d.c.	Audio Det.		SS-3425-2-4
L10	" variable, universal, 16-18 MH, iron dust core, Q 60 @ 30 kc	30 kc I.F.	Secor	SS-3631-1
L11	" " " " " " " " " "	" "	"	"
L12	" " " 20-50 " " " " " Q 80 @ 50 kc	100 kc Osc.	Hallen	SS-3399-1
L13	" " " 200 μh nom. " " " " Q 110 @ 1200 kc	Var. Osc.		SS-3654-1-1
L14	fixed layer "Max." HF, laminated core, 300-360 ohms	P.S. Filter		SS-427-1
L15	" variable, 3 pie, 760 μh nom., iron dust core, Q 120 @ 1110 kc	I.F. Trap		SS-3654-1-3
L16	" variable, 3 pie, 760 μh nom., iron dust core, Q 120 @ 1110 kc	IF. Trap		SS-3654-1-3
M1	Meter, 200 microamperes, 400 ohms res., with special scale +2 to 25 db. balance difference between vertical and horizontal mounting not in excess of 1/2% of full scale.	Indication	Burlington or Weston	741 801
P1	Plug & line cord assembly, #18/3 Type SJ, 10 ft. 6 in. overall length molded parallel blade rubber cap, green ground wire projecting 14" from cap. At free end peel 2" strip and tin 1/2".		Electro Cords	

Parts list for

MODEL 121 WAVE ANALYZER

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4b. Measurement of Signal Levels: After going through the calibration procedure outlined above, the following measurement procedure should be employed.

4b1. Connect the wave analyzer across the signal circuit to be measured by means of a pair of leads to the IN(input) and GND(ground) binding posts.

4b2. Tune the wave analyzer over its entire frequency range of 15 to 500 kc and find the input signal frequency component having the largest amplitude. This is usually the fundamental if a single source of signal is acting upon the circuit; but it may be any one of a group of harmonically-unrelated signals if, for example, multi-channel carrier system is involved. On this largest amplitude component, adjust the INPUT LEVEL attenuator so that the indicating meter reading occurs somewhere between -8 db and +2 db on its scale. Note the combined reading of the INPUT LEVEL attenuator dial and the indicating meter for this signal component.

4b3. With the INPUT LEVEL dial unchanged from the position arrived at in the above operation, proceed now to tune in the various other signal components whose levels are desired, and, for each one, adjust the ATTENUATOR dial to that position necessary for a meter reading in the - 10 to +2 db region of the scale. Note the combined reading of the ATTENUATOR dial and the indicating meter for each of these components.

4b4. The db differences between each of the various combined readings obtained in step 3 and the combined reading obtained in step 2(for the largest amplitude component) represent the ratios of the lower-amplitude components to the largest amplitude component.

As an illustrative example, assume the wave analyzer is being used to measure the harmonic content of a 96 kc signal generator feeding a 600 ohm circuit. The instrument is first standardized for gain as indicated in section 4a. The 96 kc input signal is then tuned in, and, with the main ATTENUATOR dial left at its "0" setting the INPUT LEVEL dial is adjusted to give a suitable reading on the indicating meter. Suppose this meter reading is "-2" db, when the INPUT LEVEL dial is set at "+10". This indicates that the fundamental component of the signal generator output has a level of + 10-2= +8 dbm. Without changing the + 10 setting of the INPUT LEVEL dial, rotate the frequency dial of the wave analyzer to tune in the second harmonic (192 kc) of the signal generator, adjusting the setting of the ATTENUATOR dial to give a suitable indicating meter reading. Suppose this meter reading is "-7" db when the ATTENUATOR dial is set at -30. From this, the second harmonic output level of the signal generator is -30 + 10-7 = -27 dbm, which is -35 db with respect to the fundamental. Other harmonic components may be measured in the same manner.

Schem Ref. No.	Description	Use	Name of Mfgrs.	Drawing Or Mfgrs. No.
R1	Resistor, fixed, deposited carb., 5,000. ohms ±1%, 1/2 watt	Input	Electro	DC-1/2C
R2	" " " " 4,500. " " " "	Input Attn	"	"
R3	" " " " 341.9 " " " "	" "	"	"
R4	" " " " 108.1 " " " "	" "	"	"
R5	" " " " 34.19 " " " "	" "	"	"
R6	" " " " 10.81 " " " "	" "	"	"
R7	" " " " 5.00 " " " "	" "	"	"
R8	" " composition, 39 " ±10% " "	V1 Cath.	Allen-Bradley	EB
R9	" variable, " 250 " " 2 "	" "	" "	SS-393-2-32
R10	" fixed, " 22,000 " " 1/2 "	" Grid	Allen-Bradley	EB
R11	" " " 12,000 " " 2 "	" Screen	" "	HB
R12	" " " 5,600 " " 1/2 "	" Plate	" "	EB
R13	" " " 82 " " " "	V2 Cath.	" "	"
R14	" " " 22,000 " " " "	" Grid	" "	"
R15	" " " 12,000 " " 2 "	" Screen	" "	HB
R16	" " " 3,300 " " 1/2 "	" Plate	" "	EB
R17	" " " 1,000 " " 2 "	B+ Filter	" "	HB
R18	" " " 1,000,000 " " 1/2 "	V3 Grid	" "	EB
R19	" " " 1,000 " " " "	" Plate	" "	"
R20	" " , deposited carb. 1,200. " ±1% " "	Main Atten	Electro	DC-1/2C
R21	" " " " 5,638. " " " "	" "	"	"
R22	" " " " 2,162. " " " "	" "	"	"
R23	" " " " 683.8 " " " "	" "	"	"
R24	" " " " 216.2 " " " "	" "	"	"
R25	" " " " 68.38 " " " "	" "	"	"

Parts list for

MODEL 121 WAVE ANALYZER

Schematic Diagram No. E-3561

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4c. Calibration Using External Source: If it is desired to use an external source for sensitivity calibration, the I.F. GAIN control on the front panel of the wave analyzer should be adjusted to produce "0" db reading on the indicating meter with both the INPUT LEVEL and ATTENUATOR dial S set at "0", the tuning dial tuned to the incoming signal and with a signal amplitude of 0.775 volts rms (the voltage developed by 1 milliwatt, i.e. 0 dbm, across 600 ohms) applied to the input terminals. With this adjustment the wave analyzer is set at its standard gain point, i.e., at normal sensitivity. For general sensitivity checks the frequency used should be about 100 kc. However, for maximum accuracy this adjustment should be made in the region of the frequencies under measurement. Always make certain that the tuning dial is set for maximum response to the input frequency.

4d. Tuning Dial: The tuning dial on the front panel reads directly in kilocycles over the signal frequency range of 15 to 500 kc. The center knob is used to turn the dial when large changes of frequency are desired, whereas the small rim-drive knob below is used for "fine" tuning. The special spiral dial scale has an effective length of 33 inches and the pointed shutter sliding vertically in the dial window indicates which section of the scale is to be read.

Measurements below 15 kc should not be attempted because an error is introduced when the frequency of the 1125-1610 kc variable heterodyne oscillator approaches that of the 1110 kc I.F. circuit. This error is evident by the large indicating meter deflection in the region of zero on the tuning dial.

4e. Injector Oscillator Harmonics: The injection voltage is selected from a portion of the Injector Oscillator circuit which is rich in harmonics in order to produce usable indicating meter deflections when the tuning dial is adjusted to the harmonics of 100 kc, i.e., to the 200 kc, 300 kc, 400 kc, and 500 kc settings. This feature is provided for a quick check on the tuning dial frequency calibration.

> CAUTION: Use only the 100 kc tuning dial setting for gain calibration purposes when using the Injector Oscillator as a source of know amplitude signal, since the harmonic voltage amplitudes differ from the amplitude of the 100 kc fundamental.

4f. Use of Head-Phones: A head-set may be used for listening to the incoming signals, by plugging into the PHONES jack below the indicating meter. The audio level is adjustable by means of the control knob labeled A. F. GAIN. Because of the sharp selectivity of the wave analyzer, only low frequency modulation components of the incoming carriers will be heard namely, those components below about 1000 cps. The head-set should be of the high-impedance type, preferably above 10,000 ohms, because low impedance phones will not respond as well.

5. MAINTENANCE

5a. General: For purposes of reference, schematic diagram E-3561-4 and parts list SA-3562-1 are attached. The Model 121 Wave Analyzer should require

Schem Ref. No.	Description	Use	Name of Mfgrs.	Drawing Or Mfgrs. No.
R26	Resistor, fixed, deposited carb., 21.62 ohms ±1%, 1/2 watt	Main Atten.	Electro	DC-1/2 C
R27	" " " " 10.0 " " " "	" "	"	"
R28	" " composition, 1,000 " ±10% " "	V3 Cath.	Allen Bradley	EB
R29	" " " 1,000 " " " "	CR1 Filt.	"	"
R30	" variable " 250,000 " " 2 "	A. F. Gain & Pwr. Sw.	"	SS-393-2-33
R31	" fixed " 1,000,000 " " 1/2 "	V3 Grid	"	EB
R32	" " " 47,000 " " " "	V3 Plate	"	"
R33	" " " 1,000,000 " " " "	V4 Grid	"	"
R34	" " " 560 " " " "	V4 Cath.	"	"
R35	" variable, " 5,000 " " 2 "	V4 Cath.	"	SS-393-2-10
R36	" fixed " 100,000 " " 1/2 "	V4 Screen	"	EB
R37	" " " 10,000 " " " "	V4 Plate	"	"
R38	" " " 1,000 " " " "	B + Filter	"	"
R39	" " " 2,200,000 " " " "	V5 Grid	"	"
R40	" " " 470 " " " "	V5 Cath.	"	"
R41	" " " 120,000 " " " "	V5 Screen	"	"
R42	" " " 10,000 " " " "	V5 Plate	"	"
R43	" " " 47,000 " " " "	CR2 Load	"	"
R44	" " " 1,500 " " " "	CR2 Filter	"	"
R45	" variable, " 250,000 " " 2 "	Inj. Osc. "W"	"	SS-393-2-9
R46	" " " 2,500 " " " "	Inj. Osc. "P"	"	SS-393-2-12
R47	" fixed " 100,000 " " 1/2 "	V6 Plate	"	EB
R48	" " " 1,500 " " " "	V6 Cath.	"	"
R49	" " " 100,000 " " " "	V6 Diode	"	"
R50	" " " 1,000 " " " "	V7 Cath.	"	"

Parts list for

MODEL 121 WAVE ANALYZER

Schematic Diagram No. E-3561

Proj. Eng. L.L.L.
Date March 10, 1953

SIERRA ELECTRONIC CORPORATION

SA-3562-1
Sheet No. 6 of 8 sheets

no maintenance during normal use except for occasional change of tubes and the removal of dust and dirt. The change of power supply regulator tubes V9, V10, and V11 may require that the regulator potentiometer "V" be readjusted to obtain the correct B-supply value of 260 volts. Adjustment "V" is located on the top of the chassis near the case of the indicating meter. The change of mixer of I.F. amplifier tubes V1, V2, V3, V4, and V5 may possibly affect the sensitivity of the instrument. Therefore, a re-standardization of gain should be made, using either the injector oscillator or an external source of known amplitude voltage preferably around 100 kc. (See instruction in section 4c. above). If standard sensitivity is found not to be attainable within the nominal ±7 db range of adjustment afforded by the I.F. GAIN control, the wave analyzer circuits should be realigned and/or re-adjusted as later described. Change of tubes V3 and V7 will require that the external tube shield and accompanying grounding clip (on pin #8) be transferred from the old tube to the replacement tube.

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5b. Injector Oscillator: If the injector oscillator tube V6 is changed, the following adjustment procedure should be followed, after allowing at least a 20 minute warm-up period:

5b1. With INJECTOR switch in CAL position and METER switch in CAL position, adjust potentiometer shaft "W" (at top left rear of chassis) with screw-driver to give "0" db reading on indicating meter.

5b2. Return METER switch to REC position and adjust frequency of injector oscillator to 100 kc by using insulated screwdriver in inductor tuning screw at location marked "H" on rear wall of chassis. Tuning can be accomplished by direct beating of injector oscillator with external frequency standard, or by tuning injector oscillator frequency for maximum deflection of indicating meter when tuning dial is set to 100 kc. The latter 100 kc. tuning dial point should, for maximum accuracy, be pre-set against an external frequency standard.

5b3. After frequency of injector oscillator has been set, the indicating meter should read "0" db (providing first that the wave analyzer sensitivity level has been properly adjusted by means of the I.F. GAIN control in accordance with the EXTERNAL CALIBRATION instructions given in section 4c above). If needle deflection on indicating meter is not at "0" db, the correct injection level can then be set by adjusting potentiometer shaft "P" (at top left rear of chassis next to shaft "W") with a screwdriver. Interaction between adjustment "H", "P" and "W" may require that the above procedure be repeated several times.

Schem Ref. No.	Description	Use	Name of Mfgrs.	Drawing Or Mfgrs. No.
R51	Resistor, fixed, composition, 1,000 ohms ± 10%, 1/2 watt	V7 Cath.	Allen-Bradley	EB
R52	" " " 1,000,000 " " "	V7 Grid	"	"
R53	" " " 1,000 " " "	V7 Plate	"	"
R54	" " " 120,000 " " "	V7 Plate	"	"
R55	" " " 56,000 " " "	V7 Grid	"	"
R56	" " wire wound, 25,000 " " 10 "	V10 Screen		
R57	" " composition 2,200 " " 1/2 "	V11 Plate	Allen-Bradley	EB
R58	" " " 1,000,000 " " "	V10 Plate	"	"
R59	" " " 39 " " "	V9 Screen	"	"
R60	" " " 47,000 " " "	P.S. Divider	"	"
R61	" variable, " 25,000 " " 2 "	P.S. Divider	"	SS-393-2-34
R62	" fixed " 39,000 " " 1/2 "	P.S. Divider	"	EB
R63	" " " 180,000 " " "	V4 Bleeder	"	"
R64	" " " 47,000 " " "	V2 Screen	"	"
S1	Switch, toggle, D.P.D.T., 3A, 125V, bat handle	Injector	A-H & H	20905
S2	" rotary, wafer, 1 section, 1 pole, 5 position	Input Atten.	Oak	SS-3582-1
S3	" " " " " 7 "	Main Atten.	"	SS-3583-1
S4	" toggle, D.P.D.T., 3A, 125V, bat handle	Meter	A-H & H	20905
T1	Transformer, power, plate and filament	Power Supp.		SS-428-1

Parts list for

MODEL 121 WAVE ANALYZER

Schematic Diagram No. E-3561

Proj. Eng. L.L.L.
Date March 10, 1953

SIERRA ELECTRONIC CORPORATION

SA-3562-1
Sheet No.7A of 8 sheets

5c. Variable Frequency Oscillator: In case it is necessary to change tube V7 (located on the under side of the chassis) in the variable oscillator circuit (to which tuning dial is connected) it may also be necessary to readjust some of the circuit constants so that the tuning dial calibration accuracy is preserved. The adjustments are accomplished as follows:

5c1. Adjust the frequency of the injector oscillator to exactly 100 kc in accordance with Para. 5b,2. above. (The INJECTOR switch is in the CAL position for this condition).

5c2. Set the tuning dial at 500 kc, the INPUT LEVEL dial at "0" and the ATTENUATOR dial at "-20" and adjust the variable oscillator trimmer capacitor "X" (with an insulated screwdriver) for maximum response (to injector 5th harmonic) on the indicating meter. The trimmer adjustment "X" is located on the under side of the chassis adjacent to the oscillator tube V7.

5c3. Set the tuning dial at 100 kc, and INPUT LEVEL and ATTENUATOR dials at db, and adjust the variable oscillator inductor screw "O" (adjacent the trimmer capacitor "X") for maximum response (to the 100 kc fundamental of the injector) on the indicating meter.

5c4. Since there is a slight amount of interaction between the settings of "X" and "O", steps 5c2 and 5c3 should be repeated three or four times to arrive at the proper final settings for these adjustments.

5c5. As a final check, tune in the 200 kc, 300 kc, and 400 kc harmonics of the injector oscillator to verify that the frequency calibration of the tuning dial is within the specified accuracy limits over the entire range.

5d. Alignment Procedure: In the event it is found necessary to electrically re-align the wave analyzer, as mentioned in 5c., the following procedure is recommended:

5d1. From a suitable low-impedance signal generator apply 3000 microvolts rms at 30 kc between grid No. 1 (Pin 4) of vacuum tube V4 and the chassis and tune I.F. coils L11 and L10 for maximum response on the indicating meter. The locking nuts on the core screws of the above coils should be loosened slightly just prior to this tuning adjustment and then re-tightened after the adjustment is completed, being careful not to disturb the settings of the adjustment screws in the tightening process. The I.F. GAIN control should be set at about its center value for the above adjustments, and the METER switch should be in the REC position.

Schem Ref. No.	Description	Use	Name of Mfgrs.	Drawing Or Mfgrs. No.
V1	Vacuum tube, type 6SB7-Y	1st Mixer		
V2	" " " "	2nd Mixer		
V3	" " " 6SN7-GT	Cath. Foll/A.F.		
V4	" " " 6SJ7	30 kc I.F. Amp.		
V5	" " " "	30 kc I.F. Amp.		
V6	" " " 6SQ7	Inj. Osc./Det.		
V7	" " " 6SN7-GT	Var. Osc.		
V8	" " " 5Y3-GT	F.S. Rect.		
V9	" " " 6Y6-G	Regulator		
V10	" " " 6SJ7	Reg. Amp.		
V11	" " " OB2	V. Reference		
Y1	Crystal, quartz, 1080 kc ±.02%	2nd. Mix. Osc.		SS-3622-1
XF1	Fuse Extractor Post, 3AG type, miniature		Littelfuse	342003
XI1	Socket, lamp, 1/2" removable faceted jewel		Johnson	147-403
XY1	Socket, crystal, .750" pin spacing, for .125" dia. pins		Millun	33002
XV1-10	Socket, tube, octal		Cinch	8AB
XV11	Socket, tube 7-pin miniature		Cinch	7EB

Parts list for

MODEL 121 WAVE ANALYZER

Schematic Diagram No. E-3561

Proj. Eng. L.L.L.
Date March 10, 1953

SIERRA ELECTRONIC CORPORATION

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5d2. Apply .04 volts rms at 30 kc between grid #3 (Pin 8) of V2 and the chassis and adjust trimmer capacitors C20 and C18 for maximum response. Since this band pass circuit is operated at "critical" coupling to obtain a flat-topped response curve, these adjustments should be made only by qualified personnel. The ATTENUATOR dial should be set at "0" db for this adjustment step.

5d3. Without disconnecting the signal generator from the above circuit location, change its output frequency to 1110 kc (at .04 volts rms) to check the operation of V2 as a mixer stage.

5d4. Connect the signal generator between grid #3 (Pin 8) of V1 and chassis ground, and, with its output set to give .037 volts rms at 1110 kc, tune the core screw adjustments of I.F. coils L5 and L4 to give maximum response on the indicating meter. (The ATTENUATOR and INPUT LEVEL dials should be set at 0 db for this adjustment). Then tune the signal generator to 1050 kc and adjust the core screw of L16 to give minimum response on the indicating meter, turning the ATTENUATOR dial down toward the -50 db position as the null adjustment is approached. Repeat the 1110 kc adjustments to remove interaction effects.

5d5. With the signal generator connected as in the above step, rotate the I.F. GAIN control over its range of adjustment to determine whether a "0" db meter reading can be obtained within the range of I.F. GAIN control. The normal I.F. GAIN control setting should not be too near either end of its range. If needed, adjustment of special coupling capacitor C9 may be made (by bending the plates slightly) to center the range of action of the I.F. GAIN control.

5d6. Connect the signal generator to the input binding posts of the wave analyzer, adjusting its output to give approximately 1 volt rms at 1110 kc. Adjust the inductor core screw marked "L" (located on chassis beneath gear train) to obtain a minimum reading on the indicating meter, using the ATTENUATOR dial down to the -40 or -50 db step if necessary. The INPUT LEVEL dial should not be changed from its 0 db setting.

5e. Special Adjustments: Changing the mixer tubes V1 and V2 may require re-adjustment of special purpose circuit constants other than those covered in the alignment instructions given in section 5d above. These include the neutralizing capacitors C4 and C11 and the cathode bias potentiometer marked "K". They are adjusted as follows:

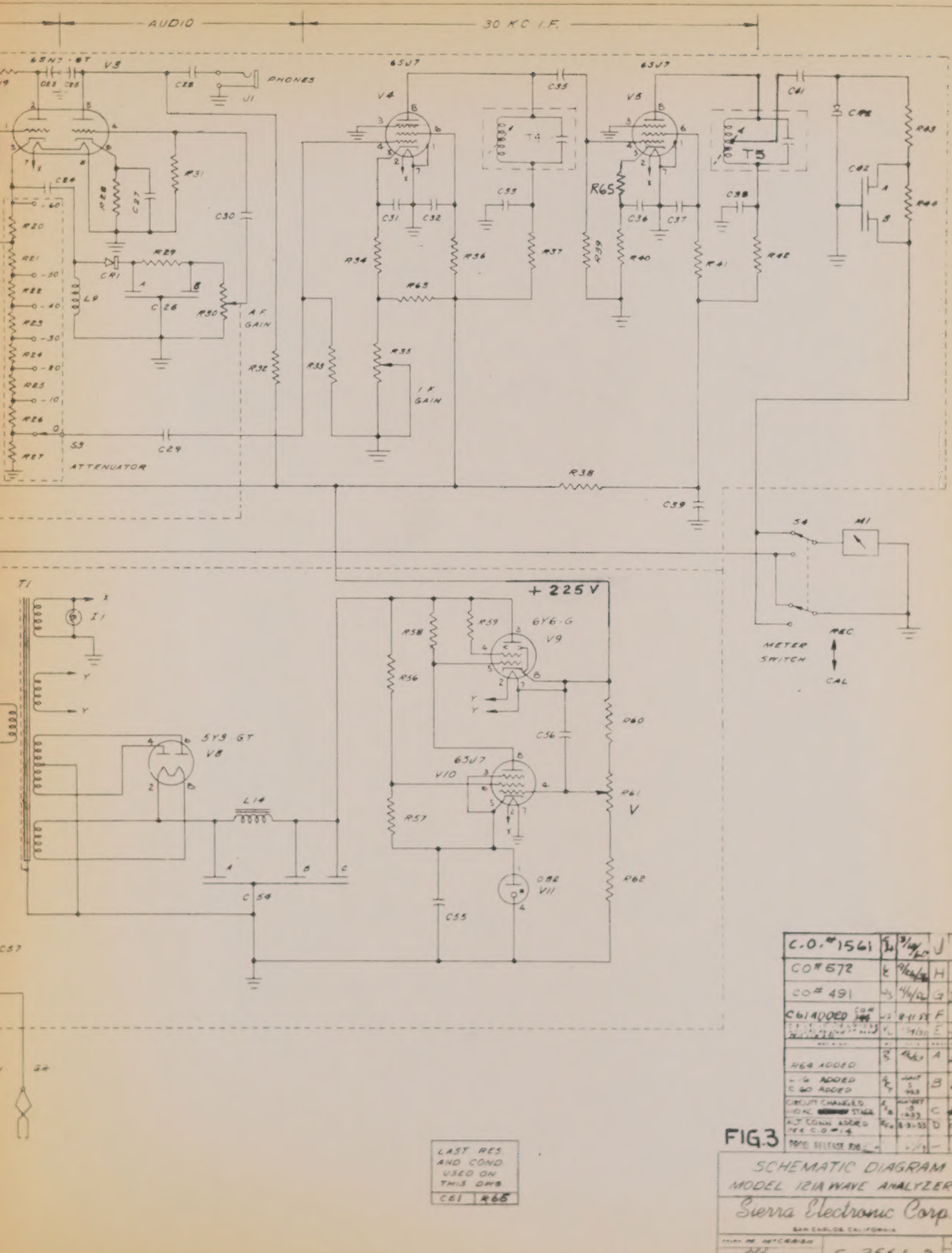
5e1. With no signal applied to the wave analyzer input, and with the ATTENUATOR and the INPUT LEVEL dials at 0 db, the INJECTOR and METER switches on REC, and the tuning dial

set at the 250 kc point, hold a low capacitance r.f. vacuum tube voltmeter (Hewlett-Packard Model 410-A or B, 1 volt range) probe on grid #3 (Pin 8) of V2 and adjust C11 for a minimum reading on the V.T.V.M.

5e2. Transfer the V.T.V.M. probe to grid #3 (Pin 8) of V1 and, in a similar manner to that followed above, adjust C4 for a minimum reading.

5e3. Remove V.T.V.M., feed a 100 kc pure sine-wave signal (i.e., harmonics at least 70 db below fundamental, by means of a good low-pass filter) into the wave analyzer input terminals at a voltage level equivalent to 0 dbm on 600 ohms (0.775 volts rms), tune wave analyzer to 200 kc and adjust potentiometer "K" for a "minimum dip" in the 200 kc response as read on the indicating meter. The adjustment produces the cathode bias value giving minimum distortion in the dynamic signal characteristic of V1. It will be necessary to turn the ATTENUATOR dial down to its -50 or -60 db position for the final stage of this adjustment if optimum results are desired.

If a pure sine-wave signal of the type specified above is not available, a compromise adjustment of potentiometer "K" can be made by feeding a 100 kc signal (of no more than 1% distortion) into the wave analyzer, tuning the dial to 100 kc and adjusting "K" to obtain its "maximum gain" position. This "maximum" will tend to be rather broad, so that the optimum adjustment point is somewhat obscure when using this compromise method. Never-the-less, reasonably good performance of the wave analyzer can be realized.



C.O.# 1561			J
CO# 672			H
CO# 491			G
C61 ADDED			F
			E
			A
R64 ADDED			
-G ADDED C 60 ADDED			B
CIRCUIT CHANGED 10 KC TO 175KC			C
R,T CONN ADDED REV C.O.# 14			D
PAPER DIELECTRIC R38			

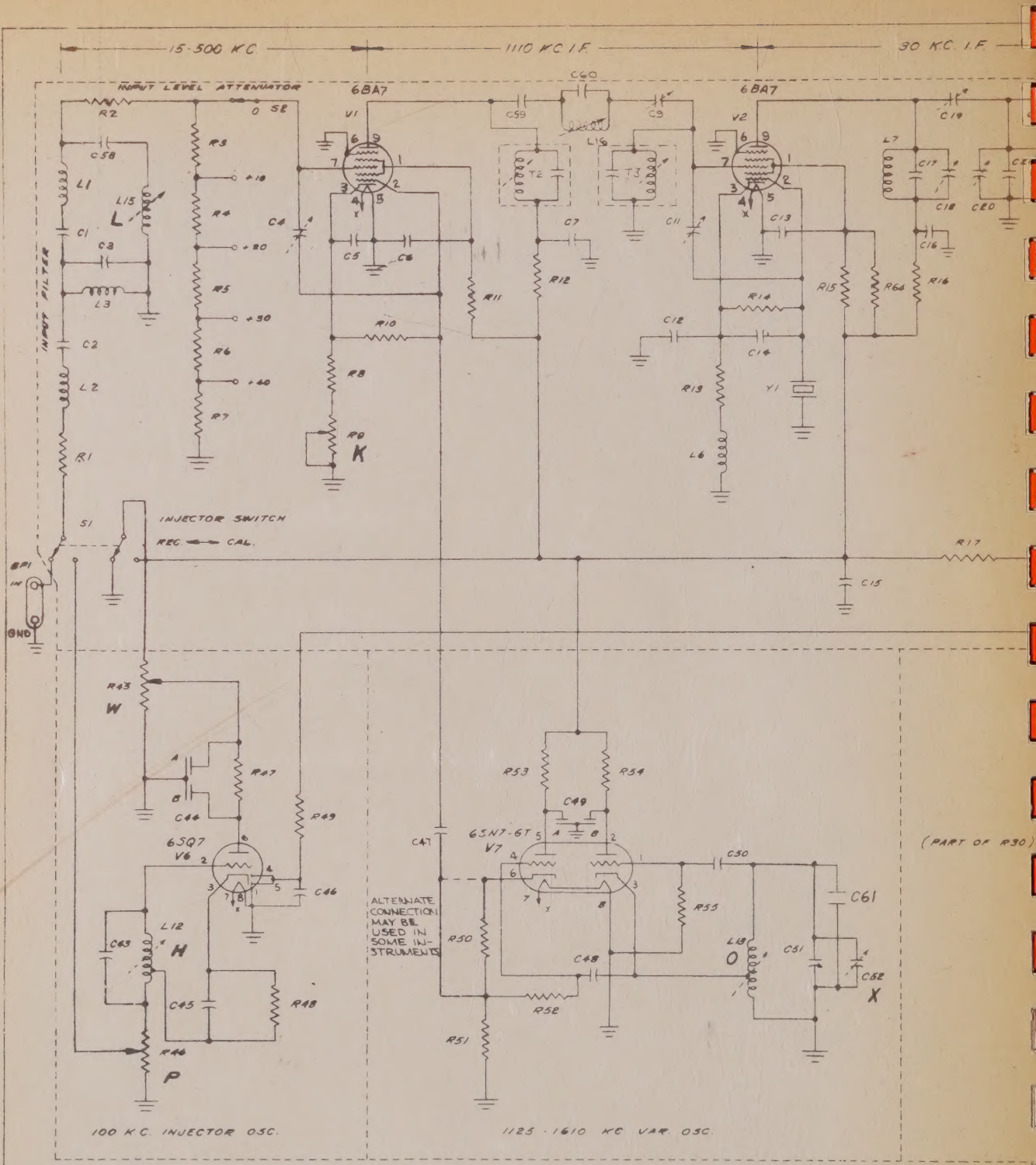
LAST RES. AND COND. USED ON THIS DWG.	
C61	R65

FIG. 3

SCHEMATIC DIAGRAM
MODEL 121A WAVE ANALYZER

Sierra Electronic Corp.
SAN CARLOS, CALIFORNIA

DRAWN BY: HT/CRB/SD		
CHKD BY: RFF	E-3561-2	J
DATE: 8-17-53		


15-500 KC.
1110 KC. I.F.
30 KC. I.F.
INPUT LEVEL ATTENUATOR
6BA7
V1
6BA7
V2
INPUT FILTER
INJECTOR SWITCH
REC. — CAL.
ANT IN
GND
6SQ7
V6
6SN7-GT
V7
ALTERNATE CONNECTION MAY BE USED IN SOME INSTRUMENTS
(PART OF R30)
100 KC. INJECTOR OSC.
1125 - 1610 KC VAR. OSC.